ELECTRIC MOTORS

MANUFACTURED BY

Siemens & Halske Electric Company

OF AMERICA.

FACTORY & GENERAL OFFICES,

CHICAGO, ILLINOIS.

July, 1893.

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ELECTRIC MOTORS.

An important patent relating to the operation of machinery by electric motors has just been issued from the United States Patent Office to Carl Hoffman and Ernst Richter of Berlin, Germany, assignors to SIEMENS & HALSKE. The inventions set forth in this patent will doubtless receive wide application and in fact most of the machinery in the factories of SIEMENS & HALSKE at Berlin, Charlottenberg and Chicago, is already operated on this principle. At Charlottenberg this patent has proved of great value and in portions of these large works there is not a foot of shafting in service.

The object of this invention is to economically and advantageously utilize electric motors for operating other machines. In order to get the best operative results from an electric motor it is essential that it be run at a practically uniform speed. The inventors sustain the motor in movable relation to the machine driven by it and utilize the weight of the motor in transmitting power to the machine by means of flexible appliances which may be modified by bodily movement of the motor.

Chief Engineer Richter read a paper at the "Electrical Technical Union," from which we extract:

Mr. Richter considers the question under three heads:

1st.—Where the electric motor takes the place of a steam engine, turbine, etc., the electric motor itself being driven from some prime mover located elsewhere.

2d.—Where the factory is divided into several departments, and for each department, or "group," a separate motor. This is called "group impulsion."

3d.—Where each individual machine receives its own electric motor. This is called "separate impulsion."

The first method is used where a waterfall is situated at a greater or less distance from the factory or the power is to be transmitted to a

distance from the point where the steam engine is located. For instance, the spinning mill, St. Blasien, is located in the Black Forest, on a suitable site nearly a mile distant from a waterfall. A turbine of 200 H. P. is built at the fall and its power used to drive an electric generator. The resulting electricity is transmitted to the mill where it drives an electric motor, giving 150 H. P. on the main shaft of the mill.

This system is also useful where the steam engine is located in one building and the power used in several different buildings as practiced in Vienna, etc., etc.

Mr. Richter mentions a sugar factory that had a steam engine located in a building distant from the boilers. This was replaced by an electric motor, with a net saving of 54.5% in the amount of steam used.

As an example of "grouping" he mentions the works of SIEMENS & HALSKE, at Charlottenberg, completed in 1890. The arc lamp factory has six floors, on each of which there is a motor driving a short transmission shaft. The latter has two safety couplings through which it is connected to two shafts extending the entire length of the room. Thus *each* room is independent of every other room, and having *two* lines of shafting, half the machinery in each room can be run or not, independently of the balance.

An incidental advantage in this system is increased safety against spreading of a fire, should such occur, as no holes or openings exist between floors or rooms as would be the case were belting used.

The saving in amount of power used by the electrical transmission above described over the previous use of shafting and belts was so pronounced that the 500 H. P. steam engine in the older parts of the works was abandoned and electric motors substituted. When it is necessary to run one or two machines at night the above arrangement proves advantageous in saving power. The loss of power by shaft and belts is far greater than is generally supposed.

When power is sold the electric motor is a convenient method of arriving at the amount actually consumed. The owner of a factory rented out some of his rooms with power. He decided to substitute electric motors for steam engines, and then ascertained for the first time that his tenants were actually consuming *double* the amount of power agreed and paid for.

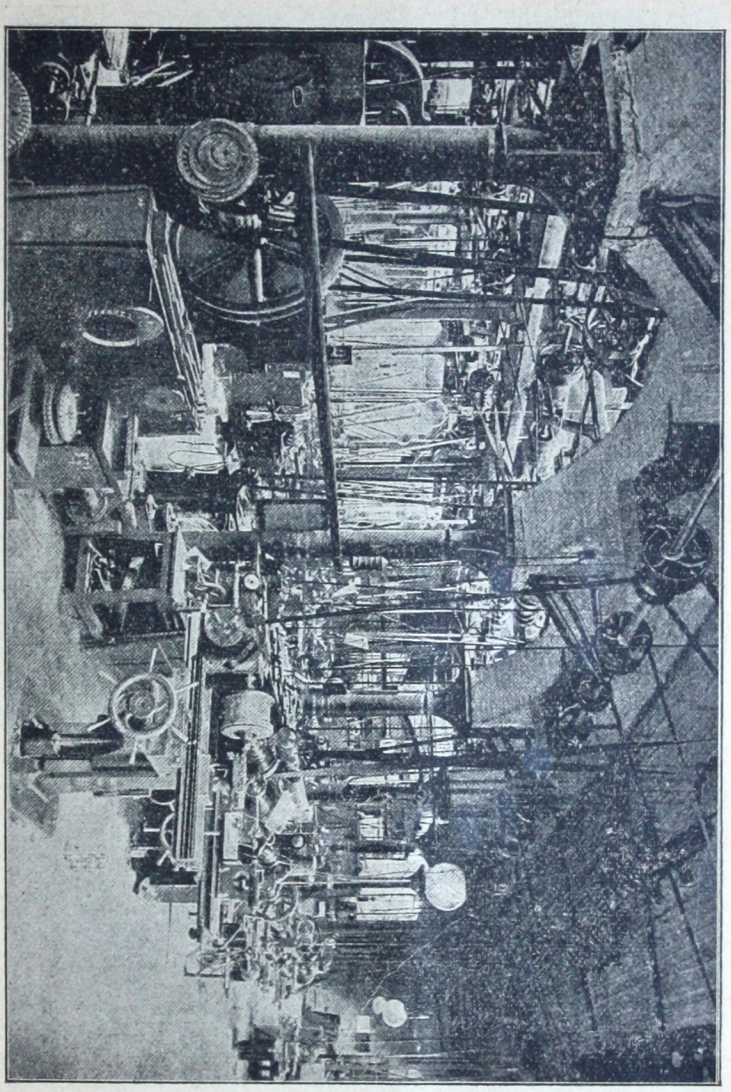

FIG. 1.

Figure 1 is from a photograph of a portion of the works of SIEMENS & HALSKE, with shafting and belts.

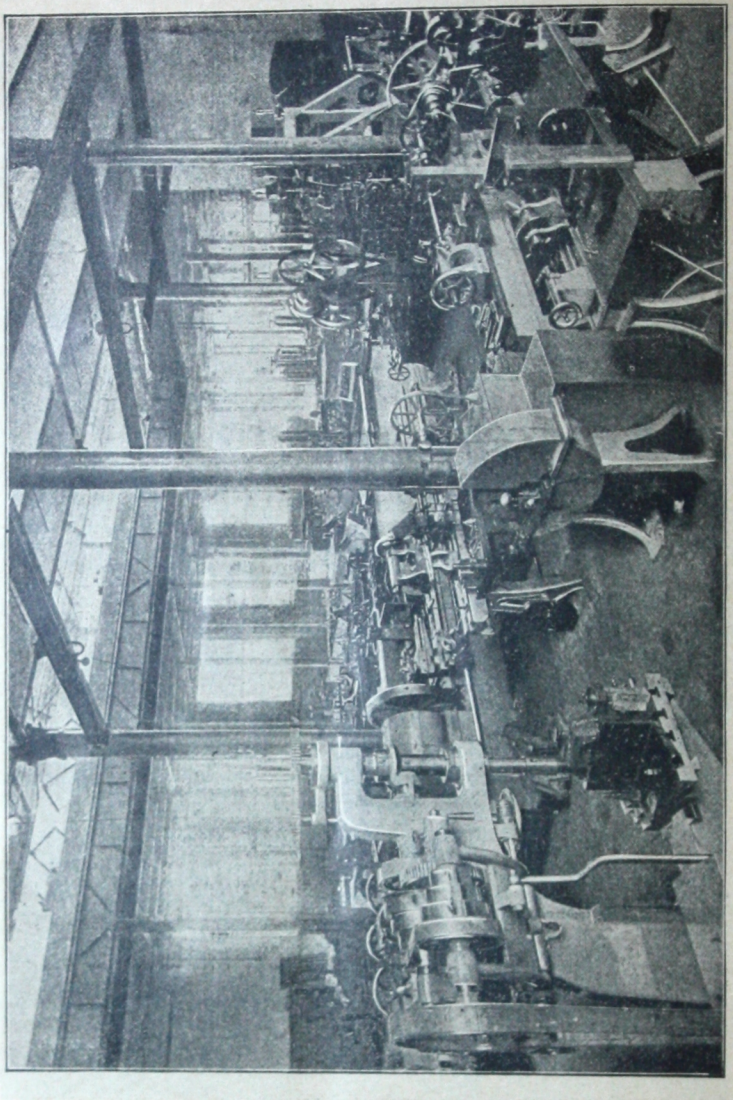

FIG. 2.

Figures 2 and 3 are photographs after Electric Motors had been installed. They tell their own story, more eloquently by the eye than could be done through words.

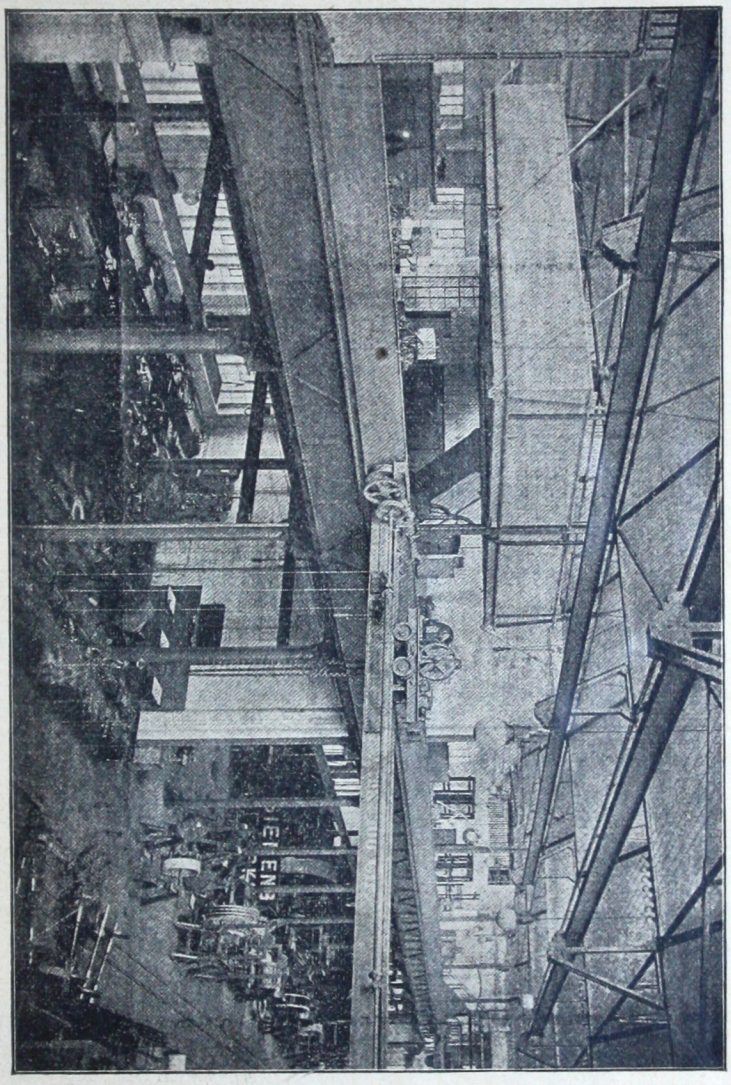

FIG. 3.

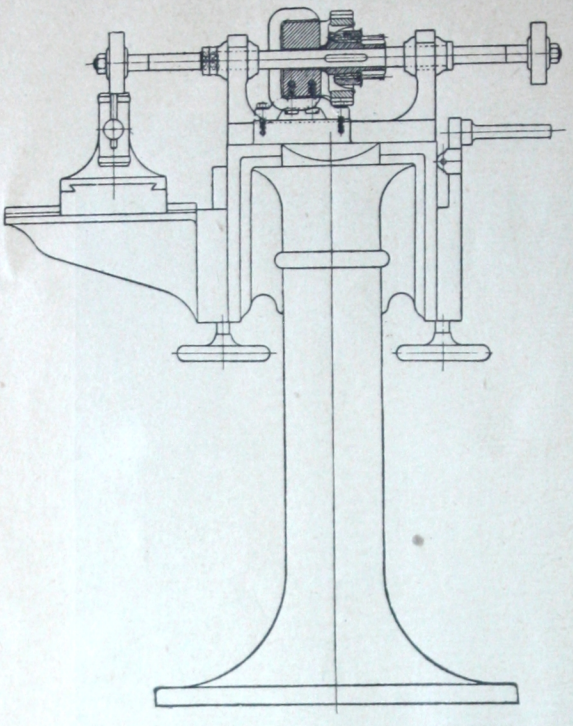

FIG. 4.

Illustrating the use of independent electric motors for various machines Figure 4 shows a double grinding machine with electric motor. Upon its axle to the right and to the left are shown emery wheels for grinding to shape or polishing.

Figure 5 shows a centrifugal extractor. The motor is applied directly to the axle of this machine. The magnetic pedestal is connected with the movable frame through a ball and socket joint, so that the motor is adjustable.

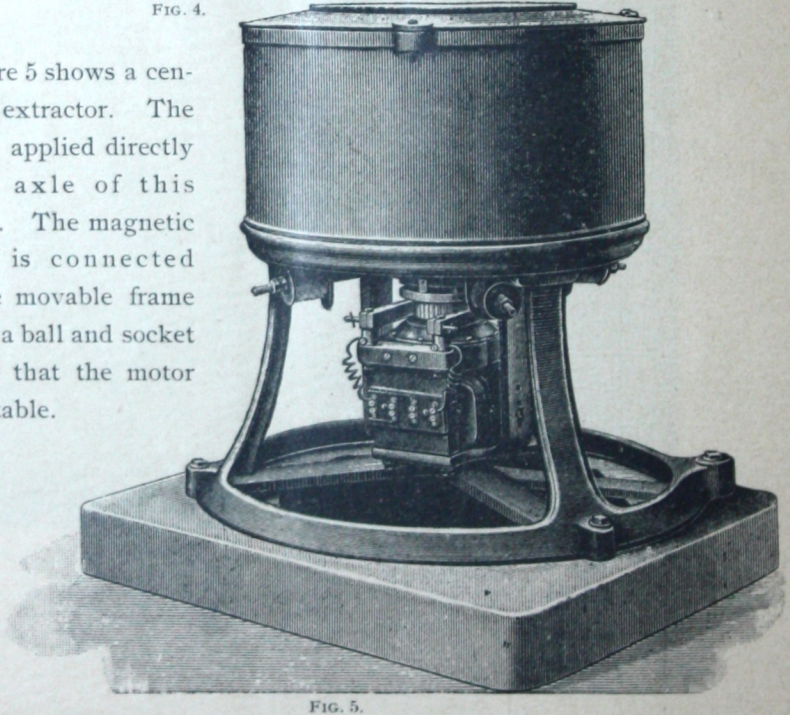

FIG. 5.

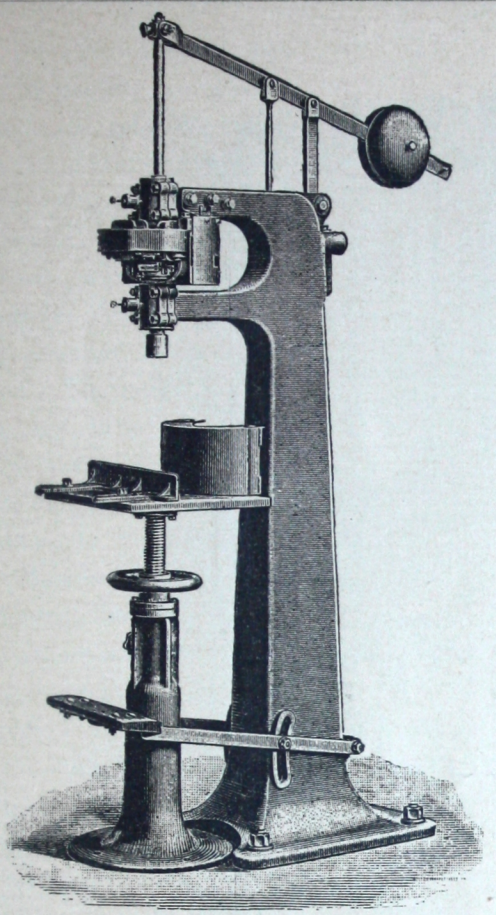

FIG. 6.

Figure 6 shows a wood-boring machine. The motor in this instance is not fastened rigidly to the axle of the machine, but has a vertical movement up or down the said axle, while it will cause it to revolve at varying heights. By means of the foot treadle the boring spindle can be moved.

In the following the electric motors are not directly connected, so that the machine runs at the same velocity as the electric motor, but the speed is varied by means of cogs, worm gears, etc.

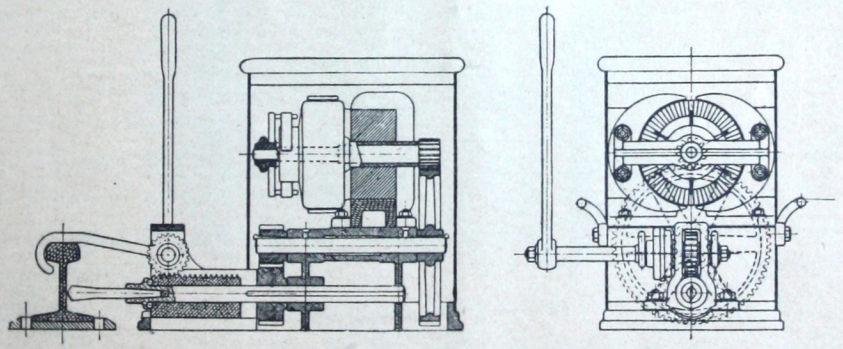

FIG. 7.

Figure 7 shows a rail-boring machine with two pair of cog wheels. The boring spindle may be slid forward or backward its entire length by means of a hand lever and gears. Friction is lessened by means of ball supports. The entire apparatus is portable.

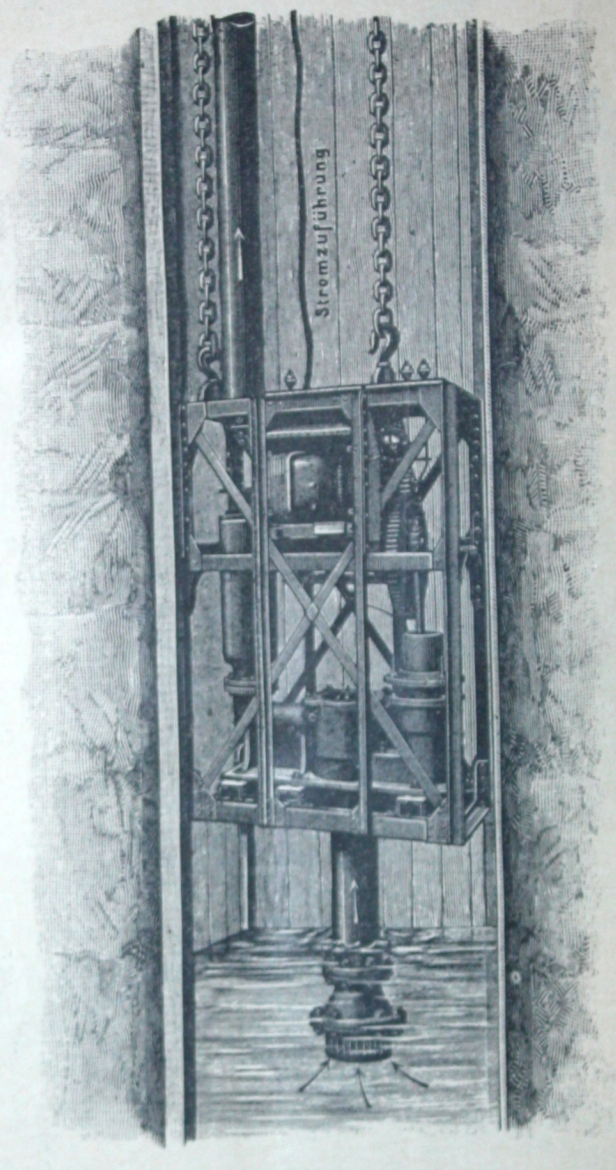

FIG. 8.

Figure 8 shows a sinking pump and is used in sinking pits or shafts. It is built into a wrought iron frame, in the top of which is placed the electric motor. The latter propels the piston of the pump by means of gearing.

Figure 9 shows a large iron planer. In greatly reduced velocity, worm gearing is often employed advantageously. With careful proportions and good workmanship an efficiency exceeding 90% is obtained by this method. Worm gearing requires little room, and its simplicity often recommends it, as, for instance, in the application shown in Figure 9. The electric motor is shown on the machine in the cut, and upon its extended axle is the worm, turning in an oil box and working main shaft. The electric motor always revolves in the same direction, but two couplings are provided, by which means the motion of the table is reversed. This gear is so arranged that the *forward* motion of the planer takes place slowly, as the machine is cutting, but the *backward* motion, no work being done, is effected at much greater speed, thereby economizing time. On each side of the machine a cut-out is provided.

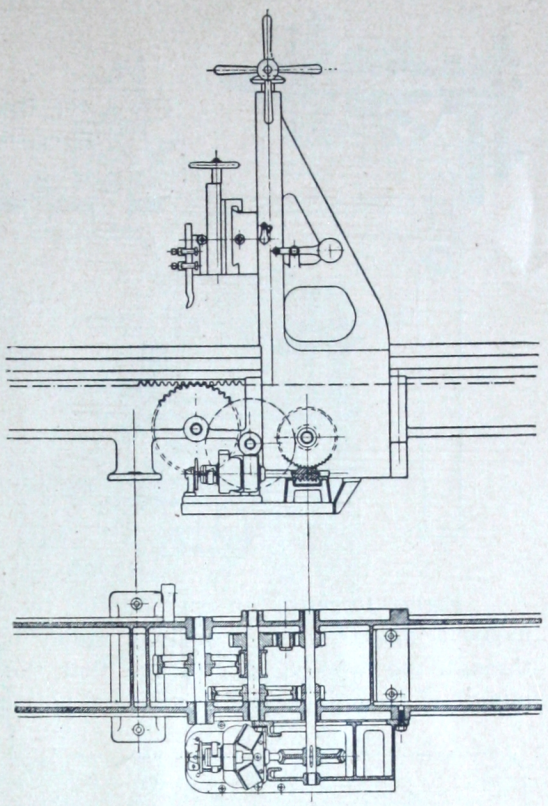

FIG. 9.

Figure 3 shows a traveling crane, carrying one electric motor upon its platform and two movable across its length. By means of the worm and worm-wheel each one of these motors operates an intermediate axle, through which the crane can be made to travel forward or backward. Weights can be raised and lowered with great ease and simplicity.

We now come to a somewhat different kind of driving, *i. e.*, to a motor with hollow axle, so that it may be slipped onto the *main* axle of a machine (or any other axle of same) and run on it, without making the same number of revolutions. In this manner the construction becomes more compact and less space is required.

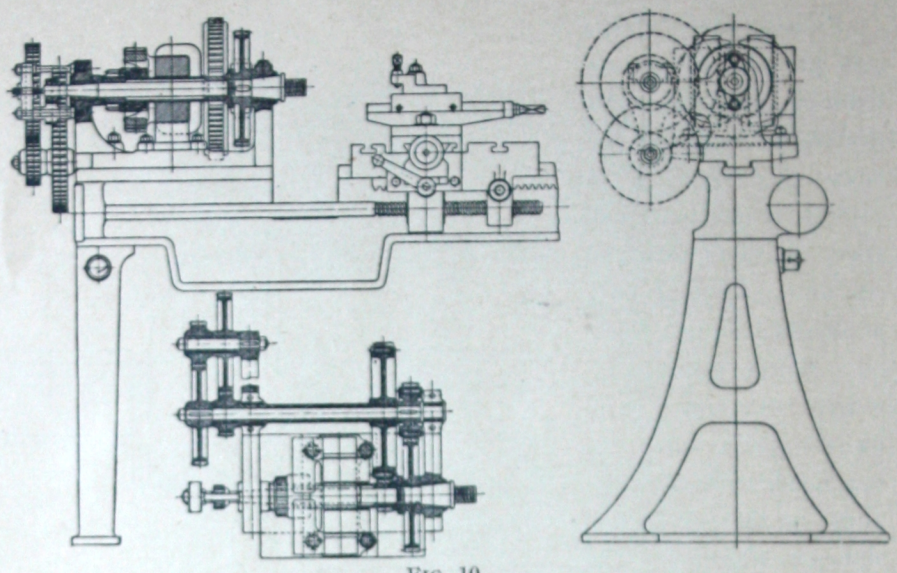

FIG. 10.

Figure 10 shows an engine lathe, thus arranged. Here the electric motor is placed where usually a pulley occurs. Motion is transmitted through cog wheels, so arranged that the number of revolutions per minute of the spindle can be varied at pleasure.

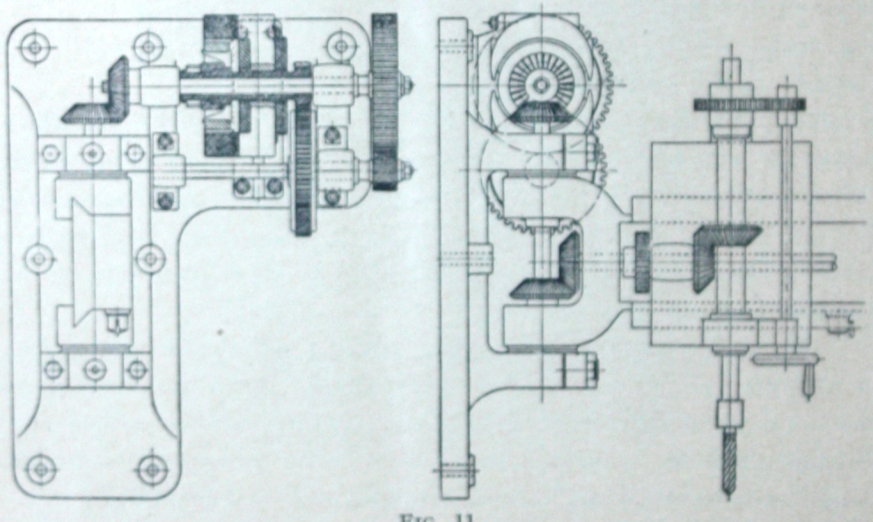

FIG. 11.

Figure 11 shows a post drill, arranged in this manner. These electric motors with hollow axles must generally be built to suit the machine they are to drive, and the machine to suit the motor.

Small machines with rope or belt driving gear are easily changed to take electric motors.

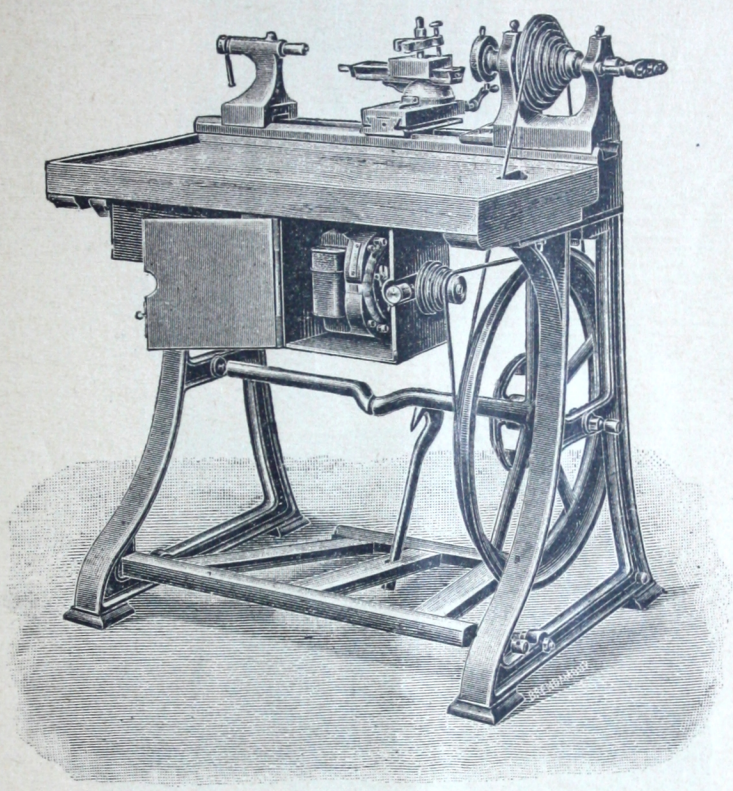

FIG. 12.

Figure 12 shows a small turning lathe with electric motor fastened to its top plate.

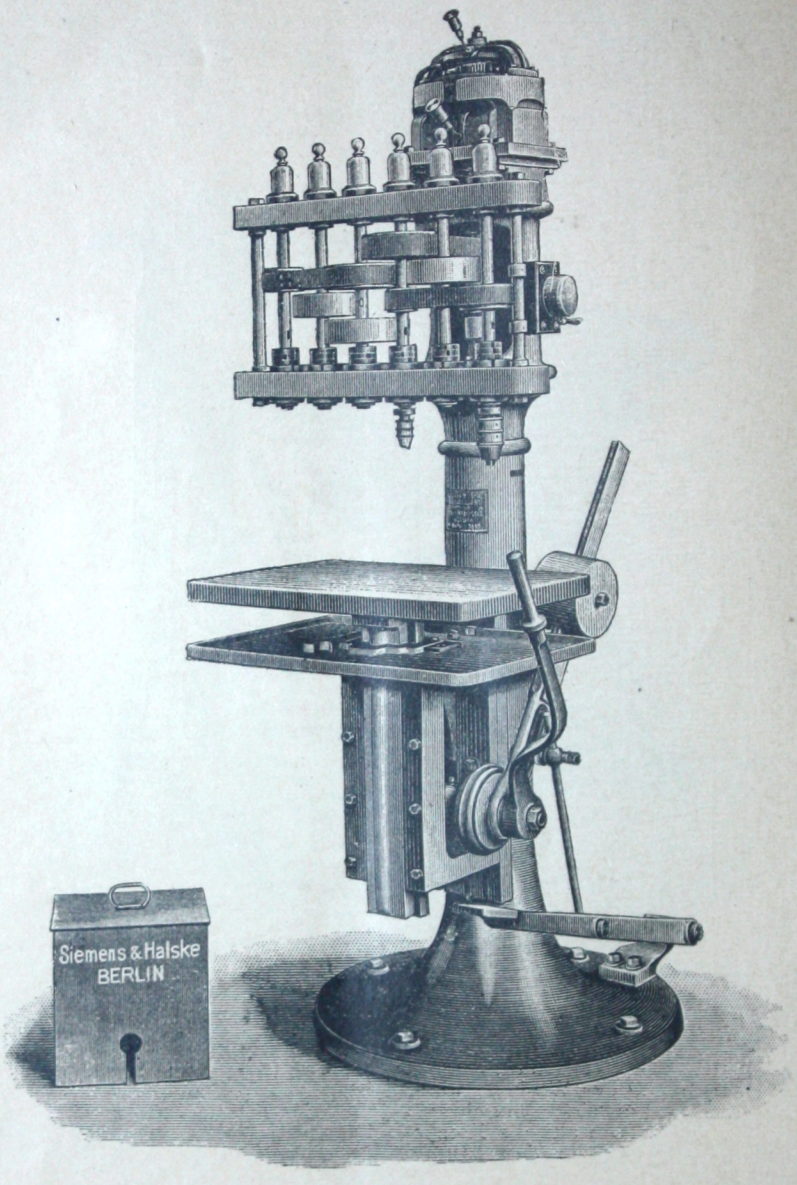

FIG. 13.

Figure 13 shows a multiple boring spindle driven by an electric motor, which is fastened upon a plate, as shown.

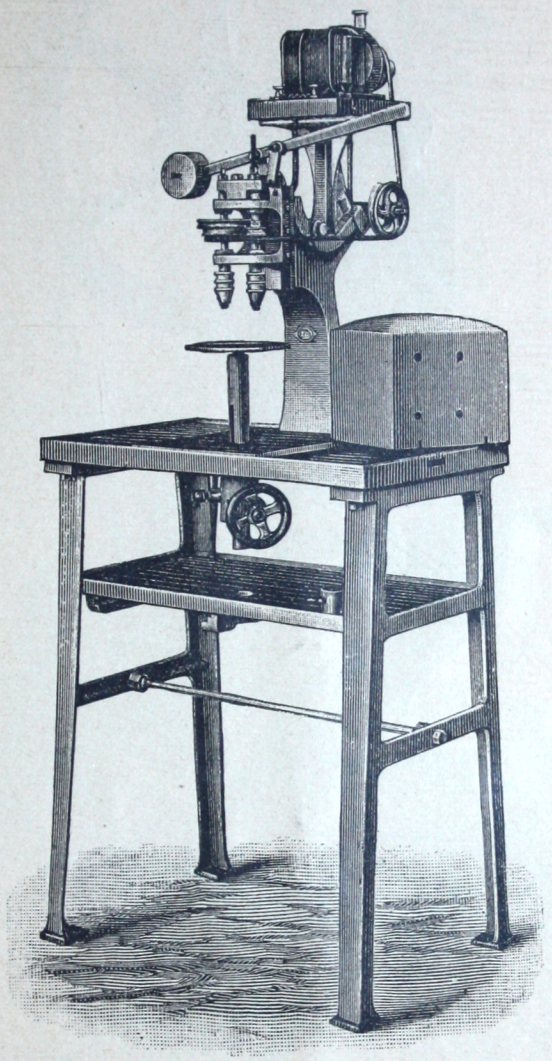

FIG. 14.

Figure 14 shows a two-spindle boring machine. The plate upon which the electric motor is placed is hinged. A spiral spring serves to keep the driving belt always taut.

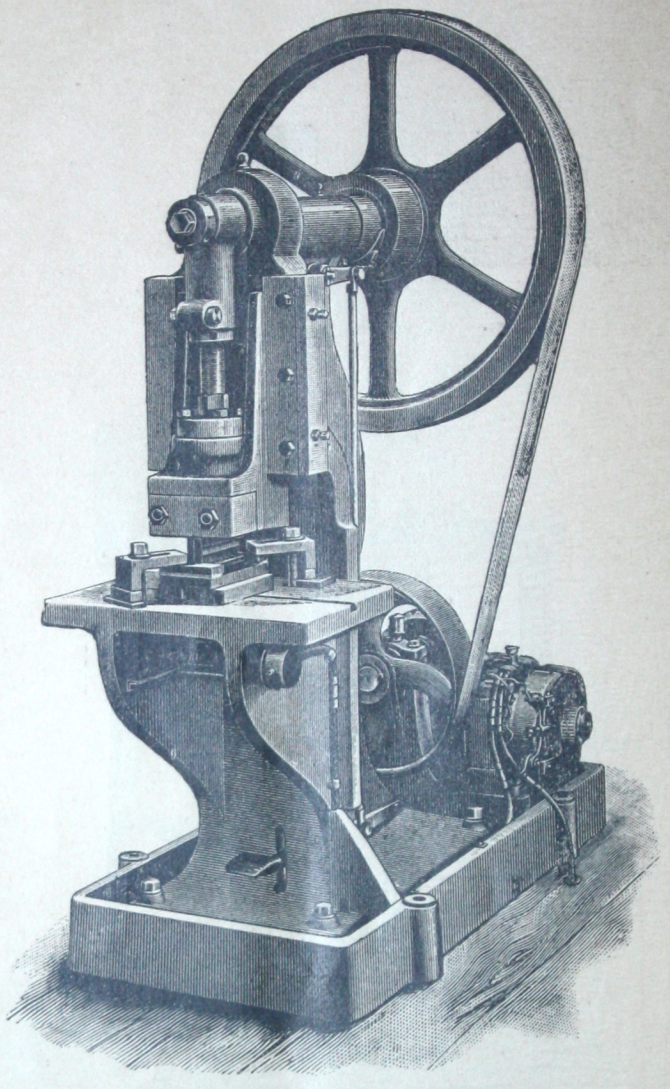

FIG. 15.

Figure 15 shows an intermittent eccentric press. The motor is mounted upon bed plate extended and has worm gear. The whole can be turned about a longitudinal axis in such a manner that the belt can always be kept taut.

Figure 16 shows an engine lathe. This machine must work with varying velocities. The electric motor is placed upon a movable bed plate. The gearing is also movable; thus the motor by its own weight stretches both belts, but this effect can be regulated by means of springs or counter weights.

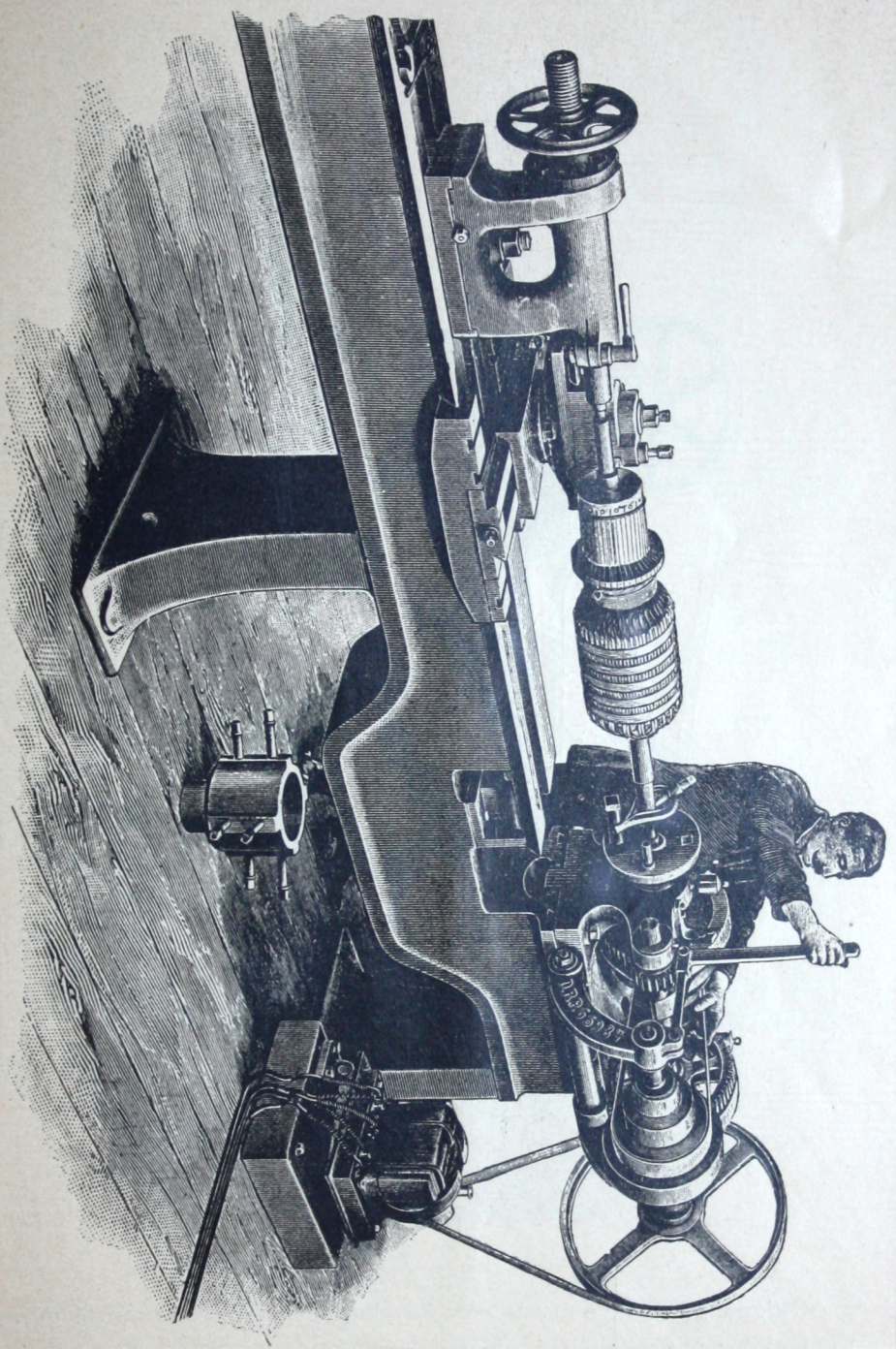

FIG. 16.

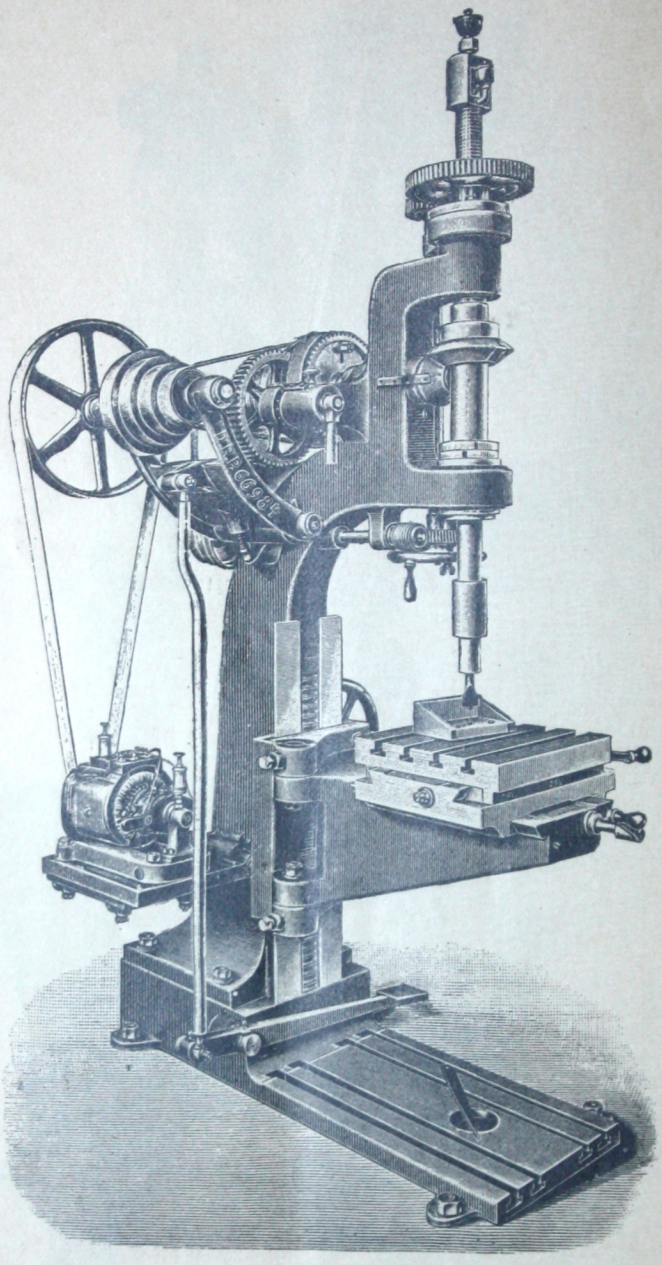

FIG. 17.

Figure 17 shows a foot-treadle for shifting belts so that the operator has both hands free, applied to a boring machine.

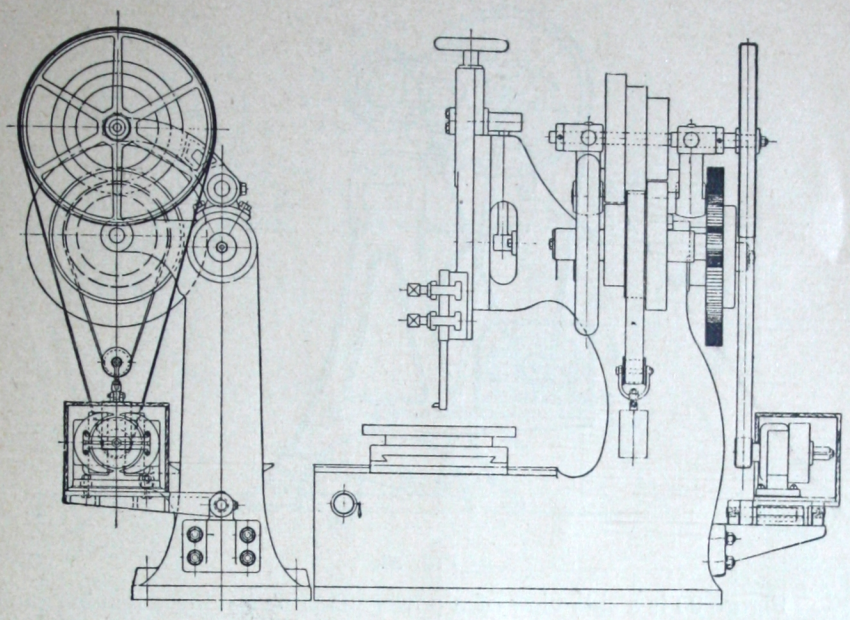

FIG. 18.

Figure 18, showing a slotting machine and Figure 19 a radial drill, require no special description.

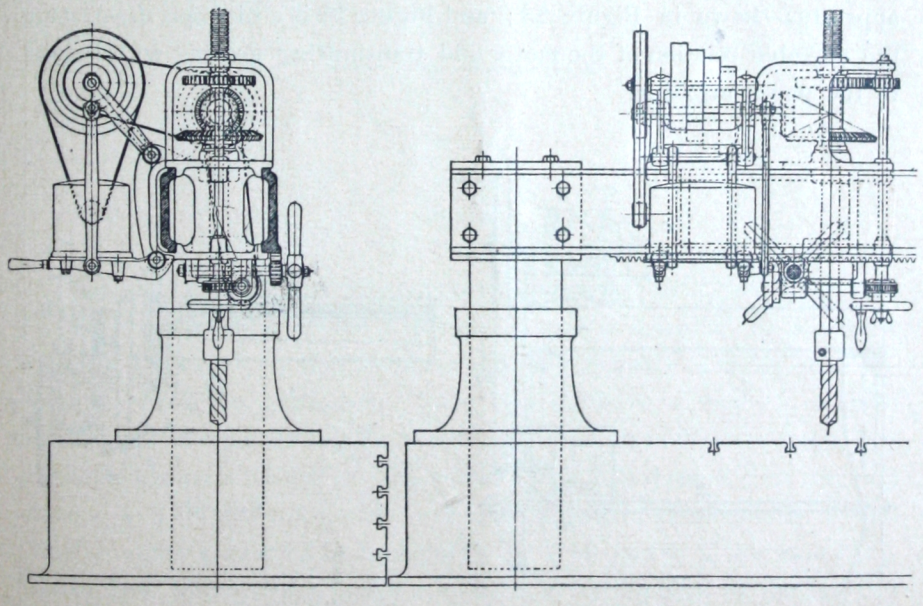

FIG. 19.

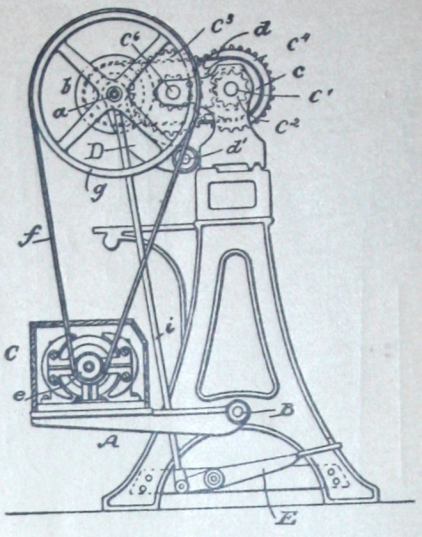

FIG. 20.

Figure 20 is a side view of a power machine having a driving motor combined therewith, in accordance with improvements. Figure 21 is a front view; Figure 22, a plan view of the apparatus illustrated in Figure 20. Figure 23 is a side elevation of a power machine combined with a motor and showing a modification. Figure 24 is a front elevation of the apparatus shown in Figure 23; and Figure 25 is a diagram illustrating the movable relation of the motor and transmitting gearing with respect to the power machine.

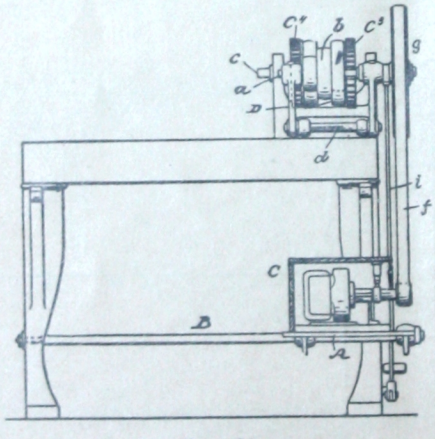

FIG. 21.

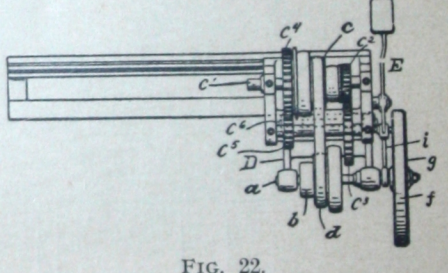

FIG. 22.

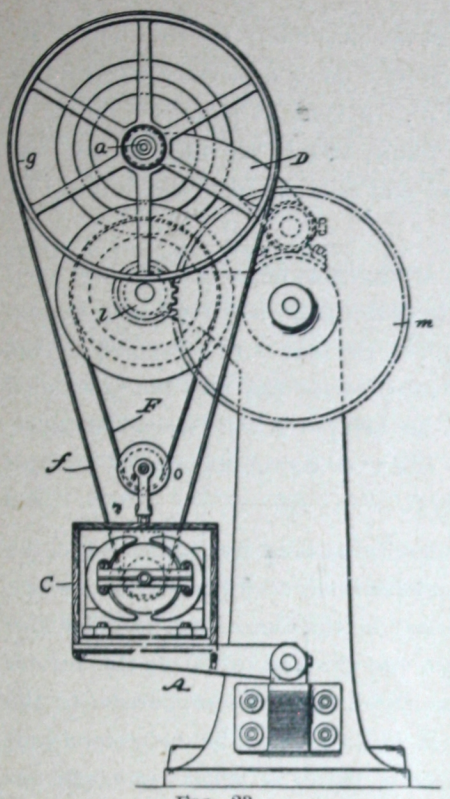

FIG. 23.

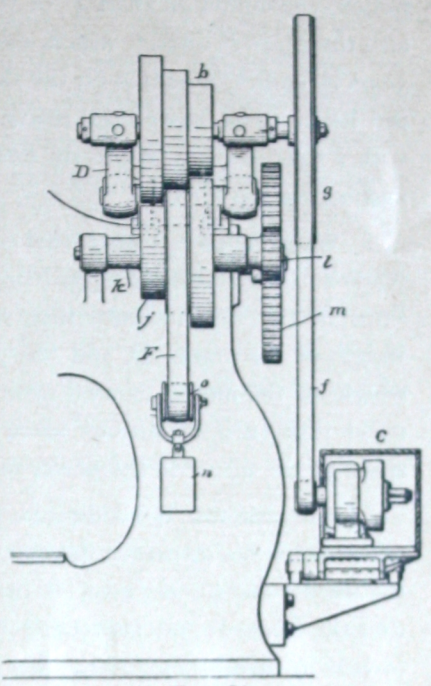

FIG. 24.

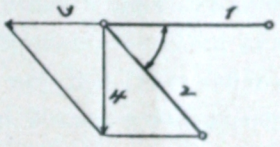

FIG. 25.

A platform A is pivotally supported at one end by a shaft B, secured in the lower portion of the frame of the power machine, or otherwise suitably supported, so that its outer end may be freely movable in an upward or downward direction. Upon this platform is mounted a small electric motor C for driving the power machine. A bracket or frame D is pivotally connected at d^1 to the power machine adjacent to its bed, and carries in its upper free portion a shaft *a*, upon which is mounted a band wheel *g* and a graduated or cone pulley *b*. The power of the motor C is transmitted through the pulley *e* upon its armature shaft by the belt *f* to the band wheel *g*, and thence through the belt *d* to the graduated or cone

pulley *c*, mounted on shaft c^1 of the power machine. On the shaft c^1 are also the gears c^2 and c^4, which, respectively, mesh with the corresponding gears c^3 and c^5, mounted on the shaft c^6. A lever E is pivoted on one of the lower cross-bars of the machine frame, and is provided at one end with a treadle plate, while its forward end is attached to the frame D by means of a rod *i*.

With the parts constructed and arranged as described, the frictional relation of the transmitting gearing will be normally positively maintained, since in the first instance the tension of the belt *d* is preserved by the weight of the frame D, and the parts carried thereby plus the suspended weight of the motor, exerted through the belt *f*. It will be readily understood that such conditions serve to effect the communication of the full speed of the motor to the power machine.

Now, should it be desired to modify or interrupt the speed of the power machine, to permit the belt *d* to be shifted, or for any other object, the treadle end of the lever is depressed by the foot of the attendant, so that the frame D and suspended motor are elevated to relieve the tension of belt *d*, thereby modifying the transmitted speed in proportion to the degree of elevation of the frame D. It will, therefore, be understood that such an operation is highly advantageous, since, as before generally explained, the desired modification of the speed of the power machine can be effected without in any way varying or affecting the speed of the motor.

The normal tension of the belt *d* is best illustrated by the diagram, Figure 25, wherein line 1 refers to the belt, line 2 the frame D, and lines 3 and 4 the compound tension force exerted by the suspended motor on the belt *d*.

In Figures 23 and 24 there is shown a construction modified to adapt the improvements for use in connection with arrangements wherein the power machine is driven by means of frictional contact pulleys. The frame D is pivoted at its inner end and carries the graduated friction pulleys *b* in fractional relation with a set of corresponding pulleys *j*, turning with a counter shaft *k* the end gear pinion *l* of which permanently engages the driven gear wheel *m* of the power machine.

The frictional engagement of the pulleys *b* and *j* is normally maintained by the weight of the motor acting through the belt *f* on the band wheel *g* on the end of shaft *a*, to which motion is communicated by said belt. The relatively reversed graduated pulleys *b*, *j* are of equal

dimensions, so that they would, in the absence of special provision to the contrary, bear a fixed relation to each other. In order, however, to permit the frictional engagement of any one of the driving pulleys *b* with the opposite driven pulley *j*, and maintain the other pulleys out of operative contact, a belt or band F is employed, which passes over one of the pulleys *j* and is given the desired tension by means of a weight *n*, carrying a pulley *o* hung on said belt.

The thickness of belt interposed between any one of the pulleys *b* and opposite pulley *j* will be sufficient to insure the communication of movement from the former to the latter while the other pulleys are out of engagement. By slightly elevating the frame D, the belt F can be readily shifted from one pulley *j* to another, and thereby vary the degree of transmitted speed without modifying the action of the motor.

The weight *n* suspended by the pulley *o* enables the belt F to have a travel corresponding with the frictional motion transmitted, so that the belt will not bind nor offer any objectionable resistance to the frictional transmission. This last described modified construction shown in Figures 23 and 24 is not essentially different in some features from the other construction shown in Figures 20, 21 and 22 of the drawings, as in both constructions the machine to be operated has a pivoted frame carrying gearing which transmits to the operative shaft or part of the machine the power derived through the belt *f* from the electric motor. The construction shown in Figures 23 and 24, however, provide for transmission of the power by utilizing the weight of the electric motor through the belt *f*, the pivoted frame D, and the cone pulley *b* upon the counter-weighted belt F, in frictional contact with one of the pulleys of the lower cone pulley *j* which is geared at *l*, *m*, to the operative part or shaft of the machine to be driven, and change of speed of the machine is provided for by simply shifting the counter-weighted belt F laterally between the opposing cone pulleys *b*, *j*, of the machine, instead of being effected by means of the treadle and rod connection E, *i*, as in the first described construction shown in Figures 20, 21 and 22 of the drawings. In the construction shown in Figures 20 and 21 of the drawings, the driving belt *f* remains taut between the motor pulley *e* and the machine pulley *g*, during the lifting of the pivoted frame D, by the treadle connections E, *i*, and the consequent yielding or slackening of the belt *d*, which slips more or less on the cone pulleys to vary the speed of the operative spindle or

part of the machine, and to an extent depending upon the range of depression of the treadle lever by the attendant. The claims of the patent, which are quite broad, are given in full below:

1. The combination with a power machine, of an electric motor and frictional transmission gear, the motor being movable in its relation to the power machine to modify the transmission gear and thereby vary the speed of the power machine without varying the speed of the electric motor.

2. The combination with a power machine, of a suspended electric motor and frictional transmission gear held in operative relation by the weight of the motor, the movable capability of the latter serving to permit the variation of the transmission gear and thereby the speed of the power machine without varying the speed of the electric motor.

3. The combination with a power machine, of a movable frame carrying transmission gearing for driving the power machine, and a pivotally supported electric motor suspended by its driving belt from the frame gearing, substantially as described.

4. The combination with a power machine, of a movable frame carrying transmission gearing for the power machine, a movable electric motor suspended by its driving belt from the frame gearing, and a foot lever and connection for vertically moving the frame to modify the relation of the transmission gearing, substantially as described.

5. The combination with a power machine, of a movable frame carrying transmission gearing imparting motion to the power machine by a belt, and an electric motor geared with the transmission gearing by a belt, said motor being movable in its relation to the power machine to release or slack the belt between the latter and the transmission gearing and still maintain the motor belt taut, substantially as described.

6. The combination with a power machine, of an electric motor, interposed mechanism for transmitting the power of the motor to the power machine, and means, substantially as described, for varying the energy transmitted without varying the speed of the motor.

7. The combination with a power machine, of an electric motor, interposed mechanism for transmitting the power of the motor to the power machine, and means for varying the energy transmitted without varying the speed of the motor, which means consists of mechanism

which acts to modify the effective weight of the motor and thereby effect alterations in the speed of the power machine.

8. The combination with a power machine, of an electric motor, interposed flexible mechanism for transmitting the power of the motor to the power machine, and means for varying the power transmitted without varying the speed of the motor, by varying the tension exerted by the weight of the motor upon the flexible transmitting mechanism.

9. The combination with a power machine, of a pivoted platform, an electric motor mounted upon said platform, a pivoted frame carrying a band wheel and a graduated or cone pulley, a belt interposed between the band wheel and the electric motor, a belt interposed between the graduated or cone pulley on the pivoted frame and a similar pulley upon the power machine, and a device for varying the tension of said last named belt, to vary the speed of the power machine.

SIEMENS & HALSKE ELECTRIC CO. OF AMERICA will issue license to use these patents for a nominal consideration. Correspondence invited.

—THE—

Siemens & Halske Electric Company

OF AMERICA,

—MANUFACTURERS OF—

DIRECT CURRENT MULTIPOLAR DYNAMOS AND GENERATORS.

These machines are constructed with outside, revolving armatures, without and with special commutator, as desired. They have proven remarkably efficient and economical. Used largely in European Central Stations. They are slow speed machines, made for direct connection to engine without belting, and in sizes from 20 H. P. to 1,500 H. P.

HIGH SPEED BELTED SIEMENS' DYNAMOS.

These machines are copied extensively in this country as "Drum Type." We are building these machines in sizes from 1 H. P. to 150 H. P.

ALTERNATING AND MULTIPHASE CURRENT DYNAMOS.

Dynamos with laminated field and armature, in sizes from 1 H. P. to 4,000 H. P. for belted or direct coupling.

MOTORS.

Motors of every speed for direct, alternating or multiphase current, in sizes from one-tenth H. P. up to 4,000 H. P. Street car motors and kindred appliances; these motors have been made double reduction, single reduction and gearless. Durable and economical in operation.

SIEMENS' BAND LAMPS.

Lamps for direct and alternating current, for constant, potential and series machines.

CARBONS.

Siemens' arc light carbons, with either solid or soft cores, which are the most economical in the world, and give a steady light.

INSTRUMENTS.

All instruments requisite for the regulation of electric apparatus; also the Siemens' voltmeters and ammeters and Automatic Devices made in Berlin.

POWER TRANSMISSION.

Profiting by our European experience and exhaustive tests, we are prepared to estimate on power transmission intelligently and guarantee successful operation.

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